REMARKS

In Amendment B, Applicants inadvertently omitted the last two paragraphs from amended Claim 4. These two paragraphs were in original Claim 4, and should have been included with amended Claim 4, which was being changed into independent form, as stated in Amendment B on lines 5 and 6 of Page 13. As these two paragraphs were not being added in Amendment B, but were instead already present in original Claim 4 and had not been deleted, Applicants have not underlined these two paragraphs.

In this amendment, Applicants are amending Claims 4 and 9 and adding new Claims 18 to 28. Support for the main part of the amendments to Claims 4 and 9 (changing the term "below" to the term "exceeding" can be found in the original specification generally on page 16 (line 20) through page 18 (line 25) and in Figure 5, steps S8 to S10, and more specifically on page 17 (lines 4-10).

With regard to new Claims 18-28, some of these claims are reinstated versions of claims previously cancelled. More specifically, new Claim 18 is based on Claim 2 (in which, inter alia, the term "deriving a variation" has been changed to the term "determining a variation"); new Claim 19 is based on Claim 3; new Claim 21 is reinstated Claim 7; new Claim 22 is reinstated Claim 8; new Claim 25 is reinstated Claim 12; new Claim 26 is reinstated Claim 13; new Claim 27 is reinstated Claim 14 and new Claim 28 is reinstated Claim 15. Since Claims 2, 3, 7, 8, and 12-15 (now renumbered, respectively, as new Claims 18, 19, 21, 22 and 25-28) were previously rejected in the Final Office Action of June 25, 2003, Applicants will now respond to those rejections in this Amendment, using the new Claim numbers.

Claims 18, 19, 21 and 22 stand rejected under §35 U.S.C. §102 (b) as being anticipated by United States Patent No. 5,790,334 to Cunningham. Applicants respectfully traverse this rejection.

The Examiner states that the Cunningham reference discloses the actual calculation or derivation of a variation in temperature of the electromagnetic transducer. The Examiner focuses on Fig. 4; column 3, lines 19-38; column 6, line 43 to column 7, line 3; column 8, line 21 to column 9, line 32; and column 9, line 58 to column 10, line 38 of the Cunningham reference. *See* page 2, the last line to page 3, line 2, and page 7, lines 11-13 of the Final Office Action. In column 3, lines 19-38, the Cunningham reference mentions that the actual bias supplied to the MR read head is adjusted to an optimum level as determined by the ratio of two resistances. The Cunningham reference also mentions that the ideal resistance ratio may be calculated based on the relative heating that occurs at each bias level. In column 6, line 43 to column 7, line 3, the Cunningham reference mentions the availability of the optimal MR read head bias. The Cunningham reference also mentions that the temperature of the MR read head can be estimated by utilizing the resistance ratio so that the resistance ratio can be used to approximate the temperature rise of the MR element and the actual temperature of the MR read head. The functions of the elements as shown in Fig. 2 are described in column 8, line 21 to column 9, line 32. The Cunningham reference discloses controlling the actual resistance ratio in order to set the MR head bias supply level in Fig. 4; and column 9, line 58 to column 10, line 38. During this processing, the actual resistance ratio is approximated by the ideal resistance ratio.

On the other hand, the present invention of the independent Claim 18 and 21 actually calculates the variation or rise ΔT in temperature, such as by utilizing the following equation (which is recited in Claim 23, which refers back to Claim 21):

$$\Delta T = \frac{\Delta R}{R_{ini}}\gamma = \frac{R - R_{ini}}{R_{ini}}\gamma$$

See, e.g., page 15 of the present specification. The Cunningham reference fails to concretely explain how to calculate the variation in temperature of the electromagnetic transducer.

Certainly, the Cunningham reference mentions that the resistance ratio serves as an approximation of the temperature rise of the MR read heads 108 in column 8, lines 52 to 54. The Cunningham reference also mentions that the temperature of the MR read head can be estimated by utilizing the resistance ratio in column 6, lines 61-66. However, Applicants believe that this mention would not lead one of ordinary skill in the art to an actual calculation of the variation in temperature of the electromagnetic transducer. The resistance ratio may indicate an approximated value of the variation in temperature, however, the resistance ratio does not indicate its actual value. It is evident that the magnitude control of the sensing current can be achieved with high accuracy by utilizing the actual value of the variation in temperature rather than utilizing the approximated value of that. Accordingly, Applicants submit that independent Claims 18 and 21, and associated dependent Claim 19, 20, and 22-24 should be allowed.

Additionally, Applicants also assert that the Cunningham reference fails to disclose the determination of an expected lifetime of the electromagnetic transducer defined in dependent Claims 19 and 22. As described above, Claim 19 is derived from cancelled Claim 3, but the term "deriving" utilized in cancelled Claim 3 has been changed to the term "determining" in Claim 19.

Claim 22 is a restatement of cancelled Claim 8. Claims 3 and 8 stood rejected under 35 USC §102(b) as being anticipated by the Cunningham reference in the Final Office Action. The Examiner states that the Cunningham reference discloses the actual calculation of the expected lifetime of the electromagnetic transducer. The Examiner focuses on the Abstract, lines 14-16; column 3, lines 53-63; column 6, lines 43-54; and column 9, lines 46-57 of the Cunningham reference. *See* page 3, lines 5-8 and page 9, lines 8 and 9. The Abstract, lines 14-16, mentions that the maximum allowable bias current level is controlled so as to preserve the overall life expectancy of the MR heads. The Cunningham reference also mentions that the maximum allowable bias current level is not exceeded in order to preserve the overall life expectancy of each MR head (column 3, lines 59-61). Column 6, lines 43-54, mentions that the maximum allowable bias current level is determined so as to preserve the overall life of each individual MR head. In order to determine the desired current levels, the Cunningham reference derives a plot of head lifetime vs. temperature for the MR stripe. *See* column 9, lines 46-57.

On the other hand, the present invention calculates the expected lifetime [hour] of the electromagnetic transducer, such as by utilizing the following equation:

$$\tau = \frac{1}{J^2}\alpha \cdot \exp\left(\frac{1}{T}\beta\right)$$

See page 15 of the present specification. The representation J specifies the current density (quantity of the current per unit cross-sectional area) of the MR element 45. The representation T specifies the temperature [K] of the MR element 45. From the foregoing, Applicants submit that the Cunningham reference fails to concretely disclose the actual calculation of an expected lifetime of the

electromagnetic transducer. Thus, for these reasons, Applicants respectfully submit that Claims 19 and 22 should be allowed.

Applicants respectfully request clarification in a contradiction in the Examiner's statements. The Examiner states that "[h]owever, Cunningham do not teach deriving an expected lifetime of the electromagnetic transducer based on the variation in temperature when determining the magnitude of the sensing current..." in the Notice of Allowability, on page 2, item 2, lines 12-14. Please clarify why Claims 3 and 8 were rejected in the Final Office Action when the Examiner seems to accept the patentability of the Claims 3 and 8 in the Notice of Allowance.

Claims 25 and 26 stand rejected under 35 U.S.C. §102(e) as being anticipated by United States Patent No. 6,476,602 to Gray. Claims 27 and 28 stand rejected under 35 U.S.C. §103 as being unpatentable over the Gray reference in view of the Cuningham reference. Applicants respectfully traverse these rejections.

Applicants submit that the Gray reference completely fails to disclose or even suggest a supply of an electric current having values (first and second current values) to the electromagnetic transducer in order to determine the magnitude of sensing current. This feature is defined in independent Claim 25. As described above, Claim 25 is a restatement of canceled Claim 12. Claim 12 stood rejected under 35 USC §102(e) as being anticipated by the Gray reference.

In the Gray reference, the embodiment shown in Figure 6 is different from the embodiment described in column 4, lines 41-59. The Figure 6 embodiment is described in column 6, lines 7-27. The computer 450 controls the current source 302 to supply the current $I_{BIAS.NOM}$ having a pregiven value to the Hall sensor 220. The computer 450 measures the voltage V_1 across the current source 302 in response to supply the current $I_{BIAS.NOM}$ to the Hall Sensor 220. The computer 450 calculates the impedance Z_{HALL} based on the current $I_{BIAS.NOM}$ and the measured voltage V_1. The

calculated impedance Z_{HALL} is compared with the nominal impedance value Z_{REF} stored in memory 452. The bias current I_{BIAS} is determined based on this comparison.

Fig. 3 shows the block diagram of the Hall sensor bias circuit of the embodiment described in column 4, lines 41-59. The current control and temperature compensation circuit 308 controls the current source 302 to supply the bias current I_{BIAS} to the Hall sensor 220. The impedance Z_{HALL} is measured by monitoring the voltage V_1 across the current source 302 in response to supply the bias current I_{BIAS} to the Hall sensor 220. The current control and temperature compensation circuit 308 also controls the current course 304 to supply a bias current I_{BIAS} to the reference load 306 not to the Hall sensor 220. The impedance Z_{REF} is measured by monitoring the voltage V_{REF} across the current source 304 in response to supply the bias current I_{BIAS} to the reference load 306. The current control and temperature compensation circuit 308 measures the difference between the impedance Z_{HALL} and the impedance Z_{REF} and modulates the bias current I_{BIAS} to remove or reduce the dependence of V_{HALL} on the temperature T_{HALL} of the Hall sensor 220.

From the foregoing, neither the Figure 3 embodiment nor the Figure 6 embodiment discloses supplying an electric current having different values (first and second current values) to the electromagnetic transducer (Hall sensor) in order to determine the magnitude of sensing current. Accordingly, independent Claim 25 (and associated dependent claims 26-28) should be allowed into a patent.

For all of the above reasons, Applicants request reconsideration and allowance of the claimed invention. Should the Examiner be of the opinion that a telephone conference would aid in the prosecution of the application, or that outstanding issues exist, the Examiner is invited to contact the undersigned.

Respectfully submitted,

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